

CLAIMS

Having described the preferred embodiments, the invention is now claimed to be:

1. A magnetic resonance imaging method for performing multi-slice magnetic resonance imaging of a region of interest of an associated imaging subject (16) using a radio frequency coil (40) arranged to generate a B_1 magnetic field in the region of interest, the method comprising:

determining a per-slice B_1 field value for each slice that is representative of the B_1 field over a selected area of the slice;

determining an adjusted per-slice radio frequency excitation for each slice that adjusts the B_1 field value for the slice to a selected value;

acquiring magnetic resonance imaging data for each slice using the adjusted per-slice radio frequency excitation for that slice; and

reconstructing the acquired magnetic resonance imaging data into a reconstructed image representation.

2. The method as set forth in claim 1, wherein the determining of a per-slice B_1 field value for each slice comprises:

determining the B_1 field across at least the selected area of the slice; and

computing an aggregate value of the determined B_1 field across the selected area of the slice.

3. The method as set forth in claim 2, wherein the computing of an aggregate value comprises:

computing an average, median, or root-mean-square value of the determined B_1 field across the selected area of the slice.

4. The method as set forth in claim 2, wherein the determining of the B_1 field across at least a selected area of the slice comprises:

computing the B_1 field numerically using a model (40') of the radio frequency coil (40) and a non-homogeneous model (16') of the imaging subject (16), the non-homogeneous model (16') of the imaging subject (16) employing different

conductivity and permittivity values for different materials of which the imaging subject (16) is formed.

5. The method as set forth in claim 4, wherein the non-homogeneous model (16') of the imaging subject (16) is a non-homogeneous model (16') of at least a portion of a human imaging subject (16), the model (16') employing different conductivity and permittivity values for different types of tissue.

6. The method as set forth in claim 2, wherein the determining of the B_1 field across at least the selected area of the slice comprises:

measuring a B_1 map of at least the selected area of the slice with one of (1) the region of interest of the imaging subject (16) disposed in the radio frequency coil (40), (2) the region of interest of a representative distribution of imaging subjects acquired *a priori* in the radio frequency coil (40), and (3) a spatially non-uniform compartmentalized phantom model of at least the region of interest of the imaging subject disposed in the radio frequency coil (40).

7. The method as set forth in claim 1, wherein the determining of a per-slice B_1 field value for each slice comprises:

determining a value of a figure of merit for each slice that is representative of the B_1 field over a selected area of the slice.

8. The method as set forth in claim 7, wherein the determining of an adjusted per-slice radio frequency excitation for each slice comprises:

determining an adjusted radio frequency excitation for each slice that adjusts the B_1 field figure of merit to a selected value of the B_1 field figure of merit that is substantially the same for a plurality of slices for which imaging data is acquired.

9. The method as set forth in claim 1, wherein the determining of an adjusted per-slice radio frequency excitation for each slice includes determining an adjusted radio frequency excitation for each slice that adjusts the per-slice B_1 field value to a selected value that is substantially the same for a plurality of slices for which imaging data is acquired, the method further comprising:

determining a specific absorption rate based on the adjusted per-slice radio frequency excitations; and

conditional upon the determined specific absorption rate exceeding a regulatory safety limit, repeating the determining of an adjusted per-slice radio frequency excitation for each slice using one of a lower selected value of the per-slice B_1 field value and adjustment of at least one other imaging sequence parameter to reduce the specific absorption rate.

10. The method as set forth in claim 1, wherein the adjusted per-slice radio frequency excitations are adiabatic radio frequency excitations, and the determining of the adjusted adiabatic radio frequency excitations comprise:

for each slice, computing an adjusted adiabatic radio frequency excitation that substantially corrects for a variation of the B_1 field across the selected area of the slice to provide more uniform flip angles.

11. The method as set forth in claim 1, further comprising:

moving the associated imaging subject (16) in a direction transverse to the slices, the determining of a per-slice B_1 field value, the determining of an adjusted per-slice radio frequency excitation, and the acquiring of magnetic resonance imaging data being repeated for a stationary slice position with the imaging subject (16) moved relative to the stationary slice position between each repetition.

12. The method as set forth in claim 11, wherein the moving of the associated imaging subject (16) is one of:

in discrete steps, with the subject (16) motionless during each repetition of the acquiring, and

continuous, with the subject (16) moving during each repetition of the acquiring.

13. A magnetic resonance imaging apparatus comprising:

a main magnetic field coil (20) generating a main magnetic field;

magnetic field gradient coils (30) selectively generating magnetic field gradients;

a radio frequency coil (32, 40) arranged to generate a B_1 magnetic field in a region of interest of an associated imaging subject (16);

a radio frequency transmitter (50) selectively energizing the radio frequency coil (32, 40);

a radio frequency receiver (52) selectively sampling the radio frequency coil (32, 40); and

a processor programmed to perform the method of claim 1.

14. A magnetic resonance imaging apparatus for performing multi-slice magnetic resonance imaging of a region of interest of an associated imaging subject (16), the apparatus comprising:

a radio frequency coil (40) arranged to generate a B_1 magnetic field in the region of interest;

a means (82, 88, 110) for determining a per-slice B_1 field value for each slice that is representative of the B_1 field over a selected area of the slice;

a means (92, 112) for determining an adjusted per-slice radio frequency excitation for each slice that adjusts the B_1 field value for the slice to a selected value;

a means (10, 44, 46, 50, 52) for acquiring magnetic resonance imaging data for each slice using the adjusted per-slice radio frequency excitation for that slice; and

a means (58) for reconstructing the acquired magnetic resonance imaging data into a reconstructed image representation.

15. The apparatus as set forth in claim 14, wherein the means (82, 88, 110) for determining a per-slice B_1 field value for each slice comprises:

an electromagnetic simulator (82) receiving a digital model (16') of the region of interest and the digital model (40') of the radio frequency coil (40) and estimating the B_1 field generated across the region of interest, the digital model (16') of the region of interest mimicking non-uniform dielectric and conductivity properties of the region of interest.

16. The apparatus as set forth in claim 15, wherein the electromagnetic simulator (82) employs a finite difference time domain algorithm.

17. The apparatus as set forth in claim 14, wherein the means (82, 88, 110) for determining a per-slice B_1 field value for each slice comprises:

a means (82, 88, 110) for determining a value of a figure of merit for each slice that is representative of the B_1 field over a selected area of the slice.

18. The apparatus as set forth in claim 17, wherein the means (82, 88, 110) for determining a value of a per-slice B_1 field figure of merit for each slice that is representative of the B_1 field over a selected area of the slice comprises:

a statistical aggregation means (88) for calculating an aggregate value representative of the B_1 field over the selected area of the slice.

19. The apparatus as set forth in claim 14, wherein the means (92, 112) for determining an adjusted per-slice radio frequency excitation for each slice comprises:

a table (92, 112) of adjusted per-slice radio frequency excitation versus slice position derived from the per-slice B_1 field values.

20. The apparatus as set forth in claim 14, further comprising:

a means (88) for determining a specific absorption rate based on the adjusted per-slice radio frequency excitations; and

conditional upon the determined specific absorption ratio exceeding a regulatory safety limit, repeating the determining of an adjusted per-slice radio frequency excitation for each slice using one of lower selected values of the per-slice B_1 field value and adjustment of at least one other imaging sequence parameter to reduce the specific absorption rate.